EXHIBIT “I”

UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF NEW YORK

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FRANKLIN BUONO,

Plaintiff,

Civil Action No.: 7:17-cv-05915 (PMH)

-vs -

DECLARATION OF EXPERT THOMAS TARANTO

POSEIDON AIR SYSTEMS, VICTORY AUTO STORE, INC., VICTORY AUTO STORES, INC. d/b/a POSEIDON AIR SYSTEMS, WORTHINGTON INDUSTRIES, INC., AND TYCO FIRE PRODUCTS LP,

Defendants.

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TYCO FIRE PRODUCTS LP,

Third-Party Plaintiff

- vs –

OPRANDY'S FIRE & SAFETY INC.,

Third-Party Defendant.

----------X

Thomas Taranto, hereby declare as follows:

1. I am an Air System Engineer with the sole proprietorship Data Power Services, LLC, formed in 2005, which is an independent air system solutions provider, conducting training, system assessments and compressed air system audits for a wide range of clients, and hold the professional experience, education and expertise in this field as set forth at length in my attached curriculum vitae. In this capacity, I have been retained by Finkelstein & Partners, LLP, for expert services in the above-captioned matter and drafted an expert report dated January 8, 2002 relating to same, a true and correct copy of which is attached hereto.

2. I hereby incorporate, certify and attest to the truth and accuracy of the contents of my attached January 8, 2020 report and curriculum vitae as if set forth at length herein.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge and belief.

Dated: April 23, 2021
Baldwinsville, NY 13027

THOMAS TARANTO

dData dPower Services, LLC

Analysis and Findings
Franklin Buono – v. –
Poseidon Air Systems, et al.

Matter of Franklin Buono

Case No.: I:7:17-cv-05915-NSR-LMS

UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF NEW YORK

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Content Style Guide

REPORT STRUCTURE

The report includes multiple sections as shown in the preceding Table of Contents. Each section includes paragraphs and sub-paragraphs is outline numbered format; Section 1, para 1.1, and sub-para 1.1.1 as shown in the preceding Table of Contents.

APPENDICIES

Appendix A Restaurant Fire Suppression System Literature

> Presents open source literature that is readily available from various market actors providing; design, equipment, maintenance, service, testing, and who otherwise participate in the Restaurant Fire Suppression System market.
>
> Literature is readily available to any interested party and is freely distributed, or available with unrestricted web access, or in some cases has been reproduced from freely available web pages. Web images include the page URL in the image, for example; "http://marketactor.com/page/reference..".

Appendix B Depositions, exhibits, and discovery reviewed

> This appendix Is a listing of the materials received and cataloged. Materials may include public domain literature, texts, commercial product literature, trade articles, white papers, advertising materials, web pages, and the like. Additional, documents are included as given to me including but not limited to evidence, transcripts of testimony, photos supplied (or taken during equipment and site inspection visits), and other discovery documents.

Appendix C Author's Professional Experience

> This appendix includes the author's Cv and other professional background information.

RESERVIED APPENDICES

Appendix W Glossary

> This appendix includes descriptions of acronyms and abbreviations used in the report. In addition, there is a section with definition of terms. Where the terms are defined in an applicable Safety Codes and Standards including ASME, CGA, DOT, OSHA, PHMSA, NFPA and possibly others; the definition is listed and cited with appropriate reference to relevant Safety Code and Standard. Such Safety Codes and Standards Such codes, standards, and regulations are readily available to all parties and are often protected from reproduction by Copyright. Therefore, when these references are quoted, they are cited. However, the full document is not provided.

Appendix X References and End Notes

This appendix contains End Note entries that are indicated throughout the report. End Note references are indicated in the body of the report by superscript lowercase roman numerals for example ([iv]) would indicate an End Note reference. There maybe one or more End Note references in the report for a single End Note entry in Appendix Y.

Text Styles

Quoted Text that Is attributed to a referenced source such as a transcript, instruction manual, commercial literature, white paper, or other reference " *is placed between open and closed quotation marks* " and is indicated by blue italics font as shown here. The source for the quoted text will be indicated by some means. There may be a reference indicated with the body of the report text, or by End Note reference, or by Bates Index reference, of by some other means.

Bates Index references are contained within enclosed brackets [Bates; LLL-nnnnnn-nnnnn] where the letters "LLL" and numbers "nnnnnn" are consistent with the Bates id numbering stamped in the reference document.

Text Excerpts; longer portions of quoted text attributed to a referenced source use; centered, justified, text that is delimited by horizontal lines at the beginning and end with blue colored text between.

This is an example of the format used for Text Excerpts that are longer portions of quoted text attributed to a referenced source. The source for the text except will be indicated by some means. A Bates id or other reference may be indicated within the text excerpt as shown here.

[Bates; LLL-nnnnn-nnnnn]

Or alternatively the reference may be indicated by some other means in the body of the report preceding or following the text excerpt.

1 Introduction

This report is intended to present my evaluation and opinions with respect to the subject "incident" described as the catastrophic failure and explosion of a pressure vessel tank (also referred to as a cylinder); with identifying marks as being constructed to DOT Specification 4BW225, fire suppression tank that ruptured while being pressurized with compressed air.

The evaluation and opinions presented are supported in the following report; consistent with my review of the documents provided, Site Inspection at Oprandy's Fire & Safety Equipment (14-Aug-2018), and inspection of the ruptured fire suppression tank and related pieces at Exponent in New York, NY (16-Apr-2018).

As discovery in this matter is ongoing, I reserve the right to amend or supplement this report upon discovery of additional facts or documents material to my evaluation.

1.1 Incident Involving TYCO Fire Protection (TFP) Fire Suppression Tank Rupture

The incident giving rise to the subject action occurred at; Oprandy's Fire & Safety Equipment in Middletown, New York, Friday morning the 12th of February 2016. This incident caused to two employees to sustain severe and serious injuries.

This analysis and report evaluate the "event"; which was catastrophic failure and explosion of a TFP Fire Protection Tank identified as a component part of a restaurant kitchen fire suppression system manufactured by TYCO Fire Products L.P. (now Johnson Controls Fire Suppression Division located in Marinette, Wisconsin).

Tyco Fire Products L.P. manufactures and sells restaurant kitchen fire suppression systems including; the PYRO-CHEM KITCHEN KNIGHT™: RESTAURANT FIRE SUPPRESSION SYSTEM – PCL-240/350/550 and the PYRO-CHEM KITCHEN KNIGHT® II: RESTAURANT FIRE SUPPRESSION SYSTEM – PCL-300/460/600.

> *ThomasNet [i] provides the following business description for Tyco Fire Protection Products located in Lansdale, PA.*
>
> ***"ISO 9001:2008** REGISTERED MANUFACTURER OF INTEGRATED FIRE PROTECTION & MECHANICAL SOLUTIONS FOR COMMERCIAL, INDUSTRIAL, INSTITUTIONAL, GOVERNMENTAL & RESIDENTIAL APPLICATIONS. WATER-BASED FIRE PRODUCTS INCLUDE ALL STYLES OF AUTOMATIC SPRINKLERS, SYSTEM VALVES, GROOVED PIPE & FITTINGS, ELECTRICAL DEVICES & WATER-MIST SYSTEMS; PLUS A FULL LINE OF RESIDENTIAL SPRINKLER PRODUCTS. SPECIAL HAZARD PRODUCTS FEATURE FIRE EXTINGUISHERS & HAND LINE UNITS; PRE-ENGINEERED RESTAURANT, VEHICLE, INDUSTRIAL & GAS STATION SYSTEMS; ENGINEERED FIRE DETECTION/SUPPRESSION SYSTEMS; COMPLETE LINE OF DRY CHEMICAL, FOAM & GASEOUS EXTINGUISHING AGENTS & EXCLUSIVE HAZARDOUS SPILL & VAPOR MITIGATION PRODUCTS."***

As the manufacturer of Pre-Engineered Restaurant Fire Suppression Systems, Tyco Fire Products (TFP), manufactures a model PCL-300T Test Tank, Part No. 551024 which is listed as a component part in the Kitchen Knight® II Manual [iii] for the TFP Kitchen Knight® II Restaurant Fire Suppression System – PCL-300/460/600.

1.1.1 Identification of the ruptured TFP Fire Suppression Tank

There is conflicting information as to the exact model and part number of the ruptured TFP Fire Suppression Tank. The ruptured TFP Fire Protection Tank is identified as a component of their PYRO-CHEM Pre-Engineered Restaurant Fire Suppression Systems. The conflicting information is unclear if the tank is a component of the TFP Kitchen Knight™ system or the TFP Kitchen Knight® II system. This gives rise to uncertainty if the ruptured test tank is TFP Kitchen Knight™ model PCL-240T, Part No. 550031 Test Tank; – or – TFP Kitchen Knight® II model PCL-300T, Part No. 551024 Test Tank.

A second question identifying the ruptured TFP Fire Suppression Tank is, identifying the tank as an Agent Tank or Test Tank. It is the author's understanding that the ruptured TFP Fire Suppression Tank is a Test Tank identified by the tank's paint scheme. The top half of the tank is painted green and the bottom half is painted red which is TFP's method of identifying this as a Test Tank.

Tyco Fire Products does not affix nameplates to their Kitchen Knight™ or Kitchen Knight® II Test Tanks. In the absence of a nameplate or label, it is unclear exactly which model number and part number is correct.

Throughout this report the author will refer to the ruptured tank (also referred to as a cylinder) as the "TFP Fire Suppression Tank" or "Test Tank". When referencing the TFP Fire Suppression Tank by model and / or part number the author will reference the tank as the "TFP Kitchen Knight® II model PCL-300T, Part No. 551024 Test Tank".

It is the opinion of the author that knowing the exact model and part number is not necessary as related to the subject incident. Tanks produced for use with either TFP the Kitchen Knight™ or Kitchen Knight® II system, are the same with respect to; hazards; dangers; warnings; instructions; manufacturer design, installation, and maintenance manuals; safety; and training; for both intended or unintended but reasonably foreseeable use of the product. In addition, independent of the TFP system; the above applies equally for all personnel those charged with the purchasing, designing, installing, testing, inspecting, approving, listing, operating, or maintaining of TYCO Fire Products pre-engineered wet chemical fire-extinguishing systems in order that such equipment will function as intended throughout its life. For additional information refer to; Section 4 Conflicting Information, ¶ 4.1 TFP Ruptured Fire Protection Tank model and part number beginning on p31 of this report.

TYCO Fire Protection publishes Technical Manuals for the PYRO-CHEM Restaurant Fire Suppression Systems. There are two manuals included in the documents provided for review. The manual with pages identified as Bates: "TFP-280809-000001 to TFP-280809-000060" is the "PYRO-CHEM Kitchen Knight™ Restaurant Fire Suppression System – PCL-240/350/550 Technical Manual PC98204"[ii] which will be referenced as the "Kitchen Knight™ Manual". The manual with pages identified as Bates: "TFP-280809-000061 to TFP-280809-000113" is the "PYRO-CHEM Kitchen Knight® II: Restaurant Fire Suppression System – PCL-300/460/600 Technical Manual No. PN551274"[iii] which will be referenced as the "Kitchen Knight® II Manual"

1.1.2 Construction of the ruptured TFP Fire Suppression Tank

A component part used to manufacture the TFP PCL-300 Test Tank is a DOT Type 4BW Worthington Cylinder - Jefferson sold to Tyco Fire Products which is the cylinder that ruptured during the incident. The cylinder manufactured by Worthington Industries is marked as required by DOT (the U.S. Department of Transportation) consistent with the cylinder's construction. Other than the required DOT markings, there are no additional markings, nameplates, or labels on the ruptured TFP Test Tank.

The cylinder that ruptured was manufactured by Worthington Industries to DOT specifications for a 4BW welded type steel cylinder with a longitudinal electric-arc welded seam, a water capacity (nominal) not over 1,000 pounds and a service pressure at least 225 and not over 500 psig gauge. Construction requirements are set forth in "49 CFR. CH. 1 §178.61 SPECIFICATION 4BW WELDED STEEL CYLINDERS WITH ELECTRIC-ARC WELDED LONGITUDINAL SEAM".

The cylinder markings "4BW 225 WORTHJ 08 98 M4543" confirm that it is a DOT style (4BW 225) welded type steel cylinder with a longitudinal electric-arc welded seam and maximum working pressure of 225 psig. The cylinder was manufactured by Worthington Cylinder – Jefferson (WORTHJ) in August of 1998 (08 98). Further information for cylinder identification is related to the DOT Identification Number (M-number); M4543 (approval date 07-Aug-1991) issued to Worthington Cylinder – Jefferson by DOT's Pipeline and Hazardous Materials Safety Administration (PHMSA) Approvals and Permits Division.

1.2 TYCO pre-engineered wet chemical fire extinguishing system

TYCO (Johnson Controls) promotional literature describes the system as follows:

> **The KITCHEN KNIGHT® II Restaurant Kitchen Fire Suppression System is a pre-engineered solution to appliance and ventilating hood and duct grease fires.**
>
> *[Bates, DPSvcs-Buono-000101] and [Bates, DPSvcs-Buono-000105]*
>
> **"Complies with NFPA Standard 17A and 96".**
>
> *[Bates, DPSvcs-Buono-000101] and [Bates, DPSvcs-Buono-000105]*

1.3 National Fire Protection Association® [NFPA] Codes and Standards

The National Fire Protection Association® [NFPA] develops codes, standards, recommended practices, and guides ("NFPA Standards") through a consensus standards development process approved by the American National Standards Institute.

1.3.1 NFPA Standard 17A – "Standard for Wet Chemical Extinguishing Systems"

NFPA 17A §1.1* Scope. THE PROVISIONS OF THIS STANDARD APPLY TO THE DESIGN, INSTALLATION, OPERATION, TESTING, AND MAINTENANCE OF PRE-ENGINEERED WET CHEMICAL FIRE-EXTINGUISHING SYSTEMS THAT DISCHARGE WET CHEMICAL FROM FIXED NOZZLES AND PIPING BY MEANS OF EXPELLANT GAS. IT CONTAINS ONLY THE ESSENTIAL

REQUIREMENTS AND RECOMMENDATIONS NEEDED TO MAKE THE STANDARD WORKABLE IN THE HANDS OF THOSE SKILLED IN THIS FIELD.

NFPA 17A §1.2 Purpose. THIS STANDARD IS PREPARED FOR THE USE AND GUIDANCE OF THOSE CHARGED WITH THE PURCHASING, DESIGNING, INSTALLING, TESTING, INSPECTING, APPROVING, LISTING, OPERATING, OR MAINTAINING OF PRE-ENGINEERED WET CHEMICAL FIRE-EXTINGUISHING SYSTEMS IN ORDER THAT SUCH EQUIPMENT WILL FUNCTION AS INTENDED THROUGHOUT ITS LIFE.

1.3.2 NFPA Standard 17 – "Standard for Dry Chemical Extinguishing Systems"

NFPA 17 §1.1* Scope. THIS STANDARD INCLUDES MINIMUM REQUIREMENTS FOR DRY CHEMICAL FIRE-EXTINGUISHING SYSTEMS THAT DISCHARGE DRY CHEMICAL FROM FIXED NOZZLES OR HAND HOSE LINES BY MEANS OF EXPELLANT GAS.

NFPA 17 §1.2 Purpose. THIS STANDARD IS PREPARED FOR THE USE AND GUIDANCE OF THOSE CHARGED WITH THE PURCHASING, DESIGNING, INSTALLING, TESTING, INSPECTING, APPROVING, LISTING, OPERATING, OR MAINTAINING OF DRY CHEMICAL FIRE-EXTINGUISHING SYSTEMS IN ORDER THAT SUCH EQUIPMENT WILL FUNCTION AS INTENDED THROUGHOUT ITS LIFE.

1.3.3 NFPA Standard 10 – "Standard for Portable Fire Extinguishers"

NFPA 10 §1.1* SCOPE. THE PROVISIONS OF THIS STANDARD APPLY TO THE SELECTION, INSTALLATION, INSPECTION, MAINTENANCE, RECHARGING, AND TESTING OF PORTABLE FIRE EXTINGUISHERS AND CLASS D EXTINGUISHING AGENTS.

NFPA 10 §1.2* SCOPE. THIS STANDARD IS PREPARED FOR USE BY AND GUIDANCE OF PERSONS CHARGED WITH SELECTING, PURCHASING, INSTALLING, APPROVING, LISTING, DESIGNING, AND MAINTAINING PORTABLE FIRE EXTINGUISHERS AND CLASS D EXTINGUISHING AGENTS.

NFPA 10 §2.4 REFERENCES FOR EXTRACTS IN MANDATORY SECTIONS.

NFPA 17, STANDARD FOR DRY CHEMICAL EXTINGUISHING SYSTEMS, 2017 EDITION.

NFPA 17A, STANDARD/OR WET CHEMICAL EXTINGUISHING SYSTEM, 2017 EDITION.

1.4 Manufacturer's duty to warn of danger with use of their product

The manufacturer, Tyco Fire Products has the responsibility to meet various specific codes and standards associated with the Restaurant Kitchen Fire Suppression System. In addition to complying with specific codes & standards, manufacturers also have the more general obligation to provide adequate warnings for dangers associated with use of their product.

> *MANUFACTURER OR SUPPLIER OF GOODS HAS A DUTY TO WARN OF ANY DANGER FROM THE INTENDED OR UNINTENDED BUT REASONABLY FORESEEABLE USE OF ITS PRODUCTS.*[iv]

1.5 Communicating Dangers through labels, instructions, warnings, hazards

There are many methods that can be used to communicate dangers associated with use of a product.

Labels or nameplates affixed to the product. These labels can communicate, instructions for proper use, warnings or hazards and danger associated with use of the product. Descriptions of safe operating

environments i.e., "indoor use only", "normal operating temperature range *nnn* °F to *nnn* °F; safe operating specifications i.e., "Service Pressure, *nnn* psig", "Test Pressure, *nnn* psig", etc..

Written manuals can provide instructions, specifications, and other information that might appear on the label with more detailed information, instructions, and descriptions.

The Globally Harmonized System of Classification and Labeling of Chemicals (GHS) defines two sets of pictograms one for labeling of work place hazards and a second for transport of dangerous goods.

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2 The Incident and Investigation

1. This report section presents facts and information contained in the record of documents provided at the time of this report. Information related to the Incident and documentation of the subsequent investigation are chronicled without trying to explain why, or assess responsibility for the cause, contributing factors, analysis and findings at this point in the report.
   1.1. Location and date; Oprandy's Fire & Safety Equipment in Middletown, New York, Friday morning the 12th of February 2016.
   1.2. Two employees were injured while a tank (also referred to as a cylinder) was being filled with compressed air when the tank ruptured [Bates; Buono-Osha-0082].

> *"A fire suppression tank was being filled with compressed air when it ruptured, injuring two employees."*

   1.2.1. The tank that ruptured is a component of the Kitchen Knight® II Restaurant Fire Suppression System manufactured by Tyco Fire Products, LP (TFP).
   1.2.2. TYCO Fire Protection Test Tank model & PN; the tank that ruptured, model PCL-300T Part No. 551024 [reference page 2-10, Bates; TFP-280809-000073]

> *Kitchen Knight® II Restaurant Fire Suppression System Technical Manual (October 1, 2001 Manual No. PN551274) in the component list as a Model No. PCL-300T Test Tank Part No. 551024.*

NOTE: There is conflicting information related to identification of the exact model and part number of the TFP that ruptured during the incident (see §4 Conflicting Information, p31).

   1.2.3. Background, at Oprandy's Fire & Safety Equipment; Middletown, NY 12-Feb-2016. [Bates, Buno-Osha-0082]

> *"A fire suppression tank was being filled with compressed air when it ruptured, injuring two employees. The test tank had been designated for balloon testing of kitchen fire suppression systems and refilled repeatedly using the quarter turn ball valve assembly to throttle the flow of air into the tank until it was full, according to the gauge on the tank."*

   1.2.4. The PCL-300T cylinder use. [Bates; Buono-Osha-0034]

> *Oprandy's used the cylinder as a portable compressed air source for testing fire suppression systems at field sites. The cylinder was typically filled to its listed pressure of 225 psig.*

1.2.5. Filling the cylinder.

"The employees were preparing the cylinder for use at a customer site to conduct balloon testing. The tank was being pressurized with air to the tank's rated working pressure of 225 psig."

1.3. The cylinder (tank) Involved in the incident [Bates; Buono-Osha-0034].

"The cylinder" [TFP model PCL-300T Part No. 551024] "involved in the incident was manufactured August, 1998 by Worthington Industries in accordance with DOT4BW for pressures up to 225 psi."

1.3.1. Ruptured tank identifying marks [Bates; Buono-Osha-0082].

"The top cap of the tank was imprinted by the manufacturer with "DOT 4BW 225" and "M4543" on one side and "WORTHJ" and "08 98" on the other."

1.3.2. "DOT 4BW 225" designates the Type, size and service pressure.

1.3.2.1. (a) Type, size and service pressure. A DOT 4BW cylinder is a welded type steel cylinder with a longitudinal electric- arc welded seam, a water capacity (nominal) not over 1,000 pounds and a service pressure at least 225 and not over 500 psig gauge. Service pressure is designated as 225 psig.

1.3.3. "M4543" is the Department of Transportation (DOT) Pipeline and Hazardous Materials Safety Administration (PHMSA) Approvals and Permits Division registration "M-Number" identifying Worthington Cylinder – Jefferson, 803 State Route 307 East, Jefferson, OH 44047; Approval Date 07-Aug-1991.

1.3.4. "WORTHJ" is identification for Worthington Cylinder – Jefferson

1.3.5. "08 98" is the month year of manufacturing; August 1998

1.4. Compressed Air Source [Bates; Buono-Osha-0034].

"The [compressed air] source was a high-pressure Poseidon cascade system designed for filling breathing air tanks."

1.4.1. The Poseidon cascade system includes a multi-stage air cooled reciprocating air compressor driven by an electric motor.

1.4.2. There are also four compressed air storage cylinders (tanks), commonly referred to as a "cascade system"; that are piped to receive compressed air from the air compressor discharge. The air compressor will fill the cylinders to a maximum pressure as determined by a pressure switch adjustment on the air compressor.

1.4.3. The Poseidon cascade system consists of a quantity of 4 Taylor Wharton HC-4500 cylinders, 444 cu. ft., each, complete with CGA-347 valve (see http://www.poseidonair.com/cascade/index.htm). The cylinders are identified with DOT Classification DOT-E 9421-4500 / TP6750 identifying the manufacturer as Taylor-Wharton (Harsco Corporation), Harrisburg, PA with 4500 psig working pressure and test pressure indicated as 6,750 psig.

1.4.4. The model PCL-300T test cylinder was being filled from the Poseidon cascade system, according to Doc ID 8229161 pg 2; US Department of labor – OSHA Statement, Christopher Foust.

"On the day of the accident I was filling the cylinder from the high-pressure Poseidon system. I was going off the cylinder but the cylinders were not connected to the Poseidon compressor. The Poseidon compressor was not operative at that time."

1.4.5. The source of compressed air as per [Bates; Buono-Osha-0049]

"The cylinder" [TFP model PCL-300T] "was typically filled to its listed pressure of 225 psi from a high pressure compressed air source. The source was a high-pressure Poseidon cascade system used for filling breathing air tanks. The maximum pressure available from the Poseidon system was approximately 4000 psi. During filling, the cylinder was connected to the Poseidon with an airline with NPT quick-connect type fittings and a threaded nipple assembly. The regulator on the Poseidon system and a quarter turn ball valve were used to control the pressure. No pressure relief devices or additional safeguards from over pressure were used. The regulator on the Poseidon system was reportedly set to about 450 psi during the filling operation."

1.5. Rupture of the TFP model PCL-300T Test Tank

1.5.1. DocID 8229161, pg. 3 OSHA Statement - Christopher Foust

"The day of the accident was a typical Friday morning. I got to work at about 10:00. Brian told me I had to fill the test cylinder for a balloon test. We have at least three test cylinders for different systems. At that point because I was teaching Frank on how to do it, me and him went into the back room, I set everything up, I connected the cylinder, started filling the cylinder, never heard any air going into it, never saw the gauge ever going up, so I pressed the valve down three times and on the third time the thing exploded. The valve on the manifold was just only cracked open. I didn't hear anything going in, so I pushed down on the valve on the cylinder. Pressed it down once, it didn't do anything. Pressed it down again, it didn't do anything. Pressed it down a third time, and it exploded."

1.5.2. DocID 8229161, pg. 3; OSHA Statement - Christopher Foust

"On the day of the accident, I set the regulator pressure to no more than 450 psi. Because when you have 450 psi of pressure going in, when it hits the cylinder, the pressure drops down. Frank was standing an arm's length away. Prior to the explosion I don't remember unusual noises or other indications of a problem with the cylinder, I was training Frank on how to fill the cylinder. What happened next was I woke up on the ground with my ears ringing, a room full of smoke, and my legs were blown off."

1.5.3. DocID 8229155, pg. 2; OSHA Statement – Frank Buono

"I haven't filled test cylinders before. The day of the accident was the first time they were showing me how to do it. I saw Chris fill one about two weeks prior to the accident. The air cylinder filling is totally different. Chris grabbed a part from the other room and hooked it up to the compressor. I never used that air tank so I can't really describe how that works. There's three different filling stations and the one in the back for the air tanks is completely different. I think there's C02 and nitrogen in the front room, and in the back room is air. The tank that exploded was an air tank, not a chemical tank.

1.5.4. DocID 8229155, pg. 3; OSHA Statement – Frank Buono

"To turn on the air, Chris did something on the Poseidon air tank. I think he turned a valve. To get the air in the cylinder, he had to push down on the valve on the top of the cylinder with a screwdriver and then turn the valve on the long metal piece to let the air in. There are three tanks on the Poseidon and Chris thought maybe one tank was empty and that's why it wasn't filling, so we tried another tank. I have no idea if Chris used the pressure regulator on the Poseidon system. He wasn't looking at that while we were filling, he was looking at the top of the cylinder and I was looking at the gauge and telling him it wasn't moving. Chris never mentioned that the pressure on the regulator needed to be set or mentioned the regulator at all. I don't know if the regulator was used. I think it was filled directly from the tank. Chris would throttle the air with the valve on the long metal piece and we would look at the gauge on the cylinder to see if it was full just like when we fill a fire extinguisher. I don't know the pressure we were filling to, I just looked at the gauge to see if it was full - red, green, you know. I would fill to the little white line between the green. We just knew that the pin wasn't moving at all. Chris used a screwdriver to press down on the top of the valve on the cylinder several times. No one had told me just how dangerous this operation was...

...I don't know if there was anything unusual about filling the tank because it was my first time and I have nothing to compare it to. The tank didn't make one bit of noise. We continued to fill it, and it exploded.

2. Forensic Evaluation of Ruptured Fire Suppression Tank (Bates, Buno-OSHA-0081 to 0091)

2.1. Information for sample material received at the OSHA Salt Lake Technical Center (SLTC) 1-Mar-2016.

"SLTC received sample number L85598 reference Inspection Number 1225359. The sample consisted of a ruptured fire suppression tank (2 pieces), a quarter turn ball valve assembly, and an assembly of fittings."

2.2. Background (Bates, Buno-OSHA-0081) - This sample was evidence from an incident that occurred at Oprandy's Fire & Safety Equipment in Middletown, New York, Friday morning the 12th of February 2016. fire suppression tank was being filled with compressed air when it ruptured, injuring two employees. The tank had been designated for balloon testing of kitchen fire suppression systems and refilled repeatedly using the quarter turn ball valve assembly to throttle the flow of air into tank until it was full, according to the gauge on the tank. The remains of this ruptured tank along with the components used to fill it were sent to the SLTC to:

- examine the condition of (the cylinder for evidence of corrosion, metal fatigue, previous repair, or other influences that may have contributed to the failure.
- examine the components used to fill the tank to understand how they may have contributed to the failure.
- examine the NPT threaded connections for evidence of failure.
- address the suitability of components used to fill the tank for high pressure application.
- test the functionality of the gauge on the tank.
- approximate the pressure required to rupture the tank.

2.3. Material testing of tank sample [Bates; Buno-OSHA-0088]

Material testing of the tank sample resulted in hardness results ranging between from 8 and 12 on the Rockwell C hardness scale. This hardness can be used to approximate a tensile strength between 88 and 96 kspi for this material. With a measure wall thickness of about 1.5 mm the thin walled hoop stress model estimates a burst pressure between 1100 and 1200 psi for a material of this strength.

2.4. Discussion [Bates; Buno-OSHA-0089]

Examination of this sample provided no evidence of any contributing factors other than over-pressurization. Tank geometry, tear patterns, and examination of fracture surfaces all indicate ductile failure. No evidence could be found on the tank of corrosion, metal fatigue, or previous repair. None of the fracture surfaces examined showed any evidence of fatigue or stress corrosion cracking. The pressure required to rupture the tank can be as high as 1200 psi.

2.5. Conclusion [Bates; Buno-OSHA-0091]

The Pyro-Chem Kitchen Knight® II PCL-300 cylinder assembly (P/N 551194) [TFP model PCL-300T Part No. 551024] discussed in this report ruptured as a consequence of being over-pressurized. A regulated pressure source should have been used to prevent this from happening. Proper integration of a pressure relief valve into the system would have provided additional protection. NFPA 10 specifies training requirement for employees in

this industry. Pyro-Chem provides training specifically for the recharging users of this product.

Summary – The Direct Cause for rupture of the TFP model PCL-300T Part No. 551024 test tank supplied as a component of the Kitchen Knight® II Restaurant Fire Suppression System was over-pressurization with air pressure exceeding the normally expected burst pressure of the 4BW 225 M4543 DOT Specification Cylinder.

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3 Executive Summary

I have reviewed to varying degrees the discovery documentation available as of the time that this report was released (see Appendix B Depositions, exhibits, and discovery reviewed, pB-89). Based on my review of the available information, my knowledge, and experience with respect to compressed air systems and associated equipment used in a wide range of industries I have investigated and prepared this analysis and report of findings.

3.1 Discovery:

3.1.1 References to Discovery.

When references are made to discovery documents identification includes Bates reference numbers where available. Where Bates numbers are not available references to discovery documents may include document titles, reference numbers, computer file names and other identifying information.

Discovery documents produced by Data Power Services, LLC (DPSvcs), have Bates numbers with prefix "DPSvcs-Buono-". For a schedule of DPSvcs document production see Appendix B Section B3 List of Data Power Services, LLC Document Production, p. B-91 of this report.

3.1.2 Right to Amend this Report:

As discovery in this matter is on-going, I reserve the right to amend or supplement this report upon discovery of additional facts or documents material to my evaluation.

3.2 Presentation of reasoning, investigation, analysis, and opinions.

If called to testify in court, or other legal proceeding, I will be prepared to explain and provide additional detail and reasoning related to my investigation, analysis, and opinions.

I reserve the right to amend this report and/or alter the analysis and opinions presented, or both, on the basis of additional new information, or changes to and clarification of the existing information that may be provided to me in the future.

3.3 Background information

This analysis and report evaluate the "event"; which was catastrophic failure and explosion of a TFP Fire Protection Tank identified as a component part of a restaurant kitchen fire suppression system manufactured by TYCO Fire Products L.P. (now Johnson Controls Fire Suppression Division located in Marinette, Wisconsin).

Tyco Fire Products L.P. manufactures and sells restaurant kitchen fire suppression systems including; the PYRO CHEM KITCHEN KNIGHT™: RESTAURANT FIRE SUPPRESSION SYSTEM – PCL 240/350/550 and the PYRO CHEM KITCHEN KNIGHT® II: RESTAURANT FIRE SUPPRESSION SYSTEM – PCL 300/460/600.

The TFP ruptured Fire Protection Tank includes a DOT 4BW style low pressure cylinder Manufactured by Worthington Industries, Inc. and a valve assembly by TYCO Fire Products L.P. with the completed Test

Tank assembly identified as a component of the TFP Kitchen Knight ™ and Kitchen Knight® II Restaurant Fire Suppression System.

3.4 Investigation and Analysis

Incidents such as the one that occurred at; Oprandy's Fire & Safety Equipment in Middletown, New York, Friday morning the 12th of February 2016, are often a result of a combination of many factors, events, decisions, and actions that can occur over a time period from hours to days of time. Indeed, factors contributing to the result or outcome of an undesirable event may have occurred months or even years in the past.

There are considerations of systemic design decisions, and layers of protection in design of system elements that impact reliability or process safety. Management and governance decisions driven by cost, return on investment, time and budget constraints are potential factors. Workforce constraints including knowledge, skills, and abilities along with work practices may influence the eventual outcome. Human factors can include the work environment, distractions, complacency, overconfidence, and work stress / time pressure as they may affect performance. Supervision and management style, quality of communication, vague or incorrect guidance, and training along with a changing workplace and adoption of new technology influence behavioral functions and decision making.

There are many strategies and analytical methods used to investigate situations leading up to undesirable events or outcomes. The method used here is a form of Root Cause Analysis. Root Cause Analysis (RCA) is a cause-effect evaluation of factors where-in the result is occurrence of an undesirable event. Merriam-Webster Collegiate Dictionary 11th ed. defines "**cause**" as "*something that brings about an effect or result*" and "**root**" is defined as "*something that is an origin or source*". RCA evaluates factors to determine the origin or source that brings about the effect or result.

There are various RCA methods. The methods and definitions vary based on the technology, purpose, and organization or guiding body employing the RCA method. These methods recognize that there may be multiple root causes associated with an event. It is also commonly accepted that; as described in the US Department of Energy "Root Cause Analysis Guidance Document" (DOE-NE-STD-1004-92) p3; in the time preceding an event; *"a Chain or cause and effect sequence in which a specific action creates a condition that contributes to or results in an event"*.

3.5 Results of Investigation & Analysis

Undesirable results involving events such as this; the catastrophic failure and explosion of a TFP Fire Protection Tank, are a result of a Direct Cause (def. Appendix W ¶2.6 pW-97) along with one or more Root Cause (def. Appendix W ¶2.8 pW-98) , and a Contributing Factor Chain (def. Appendix W ¶2.10 pW-98) of events.

Investigation reveals that there are a group of factors that contributed to the final outcome resulting in the subject event; the catastrophic failure and explosion of a TFP Fire Protection Tank.

Overpressurization of the DOT 4BW 225 WORTHJ 08 98 M4543 cylinder Worthington Cylinder - Jefferson sold to Tyco Fire Products is found to be the Direct Cause of the TFP Fire Protection Tank

rupture and catastrophic failure. The TFP Fire Protection Tank includes the cylinder with a valve assembly designed and manufactured by TFP installed. The completed TFP Fire Protection Tank assembly is sold by TFP as a Test Tank component of the TFP Kitchen Knight™ and Kitchen Knight II Restaurant Kitchen Fire Suppression System which is a pre-engineered solution to appliance and ventilating hood and duct grease fires.

3.5.1 Systemic factors contributing to the event.

The TFP Fire Protection Cylinder was designed for a service pressure of 225 psig and tested to 450 psig. The burst pressure of the failed cylinder was determined to be between 1,100 to 1,200 psig (see §2. **Forensic Evaluation of Ruptured Fire Suppression Tank (Bates, Buno-OSHA-0081 to 0091)** ¶2.5 Conclusion [Bates; Buno-OSHA-0091]; p19).

During the event, the TFP Fire Protection Tank was being filled using a compressed air source of approximately 4,000 psig; a Root Cause of the event (see §2 ¶1.4.5The source of compressed air as per [Bates; Buono-Osha-0049]; p17). The source, a Poseidon cascade system with four tanks with DOT Classification DOT-E 9421-4500 / TP6750 identifying the manufacturer as Taylor-Wharton (Harsco Corporation), provided a storage volume of 444 cu. ft. per cylinder.

The 4000 psig compressed air source was connected to the TFP Fire Protection Tank using a pressure regulator that was reportedly set to regulate pressure at 450 psig (see §5 ¶5.2.2 Root Cause: Failure to limit pressure (no higher than 25 psi above operating pressure); p43).

The system design for the compressed air source is consistent with the requirements of NFPA 10 ¶ 7.8.4.5.2 providing *"A regulated Source of pressure set no higher than 25 psi (172 kPa) above the operating (service) pressure, shall be used to pressurize fire extinguishers."*. However, the regulated pressure setting was not in compliance with this NFPA requirement.

As a systemic contributing factor, beyond the pressure regulator the system has no additional layers of safety protection. Although there is no NFPA requirement, it is generally regarded as a best practice to incorporate one or more over-pressure safety device such as; a safety relief valve, over-pressure rupture disc, or blow-out plug. The system did not incorporate any over-pressure protection devices to limit compressed air pressure supplied to the TFP Fire Protection Cylinder.

A contributing factor to the event is the lack of a required engineering control, a calibrated pressure gauge for the regulated pressure source [NFPA 10 ¶ 7.8.4.5.3] *"The gauge used to set the regulated source of pressure shall be calibrated at least annually."*. There are no tags, or markings, or record of calibration for the regulator's pressure gauge.

3.5.2 Training Records

Historical training records often assist RCA in assessment of the contribution of Training as Root Cause and Contributing Factors. For this event the only training records available are based on recollection of individuals with the record established through their statements and deposition. As such the reliability of training information is subject to memories of the training process and information retained.

Training records contemporaneous with training events such as "training certificates" associated with formal training courses are the most reliable record of training. In addition, formal training will often have a syllabus that provides insight as to learning objectives, and level of learning expected as a result of participating in a training program. Records of formal training courses provide a means to gain insight to individual knowledge, skills, and abilities related to the subject matter.

As such NFPA 10 and 17A require that trained service technicians "*... shall possess a certification document confirming the requirements in 7.3.1*"; [NFPA 17A §7.3.1.1]. In addition, NFPA 17A requires the service technician "*... shall have passed a written or online test that is acceptable to the authority having jurisdiction.*" [NFPA 17A §7.3.1]. A written or online test provides a gauge to the degree which the learning objectives and levels of learning associated with the training program have been achieved.

In his statement in the OSHA investigation record [OSHA Statement Mr. Foust April 6, 2016 [115414-01(286333) - Investigations - Investigation - DocID 8229161.PDF; p1 ¶1 L5] Mr. Foust recounted that he participated in "*on-line courses about servicing fire extinguishers.*" there is no record of training, its content, or a completed written or online test.

Beyond the online training, Mr. Foust describes on-the-job-training with no record of formal training but rather describing what might be referred to as "buddy training". Buddy training without a formal syllabus may pass on bad habits which can become contributing factors to an event.

3.5.3 Knowledge, Skills, and Abilities as contributing factors to the event.

For this event, the RCA can observe that there was a lack of knowledge related to the requirement of NFPA 10 to use "*A regulated source of pressure, set no higher than 25 psi (172 kPa) above the operating (service) pressure...*" [NFPA 10 §7.8.5.4.3].

As a contributing factor there was a lack of skills and abilities to troubleshoot the problem of not hearing air flow and observing the cylinder mounted pressure gauge to assess the charging status of the cylinder.

3.5.4 Imprecise Communication as contributing factors to the event.

As a contributing factor communication related to the use of TFP Test Tanks is not only imprecise, it is virtually nonexistent. The only communication provided is the required DOT markings which are not easily understood by those who are not knowledgeable about DOT regulations set forth in CFR-2018-title49-vol3-sec178-61.

Q. The test tank in this case, in which Mr. Buono was involved with, is it your understanding that it had a PSA marked -- psi marking of 225?

A. I believe there was a DOT stamp on it of 225.

Q. And in terms of your understanding, what does that 225 psi mean to a consumer?

A. It's a DOT stamping, and I'm not completely up to speed on DOT stampings, but the 225 does signify the pressure.

[Deposition Mr. Harding p32 L6 – 18]

The TFP model PCL-300T (or PCL-240T) TFP Test Tanks do not include any product nameplate or label. In addition, there are no danger, caution, or hazard labels (see Figure 4 – Kitchen Knight Agent Tank and Test Tank photos, p37). Therefore, there is no communication to the end user to warn of any danger from the intended or unintended but reasonably foreseeable use of the product.

By comparison the TFP PCL-300 Agent Tank is marked with a nameplate label (PC5551235) which clearly lists information with bold headings of Maintenance, Recharge, Warning, and Caution (see Figure 5 – TYCO FIRE PRODUCTS NAMEPLATE PART NO. PC551235 PCL-300 AGENT TANK, p47). The label communicates specific information including "contents under pressure 225 psi ... operating pressure", and "Cylinder factory test pressure 450 psi". The nameplate label also directs the user to owner's manual, the Pyro-Chem Manual P/N 551274, and Standard for Wet Chemical Extinguishing Systems NFPA 17A; which are resources with additional information for users of the TFP Agent Tank. None of this information is communicated to users of the TFP Test Tank that ruptured during the event.

3.5.5 Vague or Incorrect Guidance as contributing factors to the event.

Vague or incorrect guidance is a contributing factor to the event. The only reference to Test Tanks is in the Kitchen Knight® II Manual [iii] which is limited to a Model No. and Part No. only. [Bates; TFP-280809-000073].

In the system recharge section of the manual the instruction for pressurizing the Agent Tank is vague stating only "*c. Reinstall valve and pickup tube and pressurize tank to 225 psi and reinstall to piping network.*" [Bates; TFP-280809-000112].

The guidance provided in the manual could be much more specific by including required elements of NFPA 10 such as; a regulated pressure source set no higher than 25 psi above the operating pressure; and, use a pressure gauge calibrated with the past year. The guidance could refer the user to NFPA 10 for additional information. Similar guidance could be added to address pressurizing TFP Test Tanks.

3.5.6 Complacency as contributing factors to the event.

Complacency is a contributing factor to the event. The lack of labels, indications of dangers, instructions, and clear concise communication to the end user as relates to use of the TFP Test Tank contributes to dangerous complacency when handling, servicing, and using TFP Test Tanks, as follows.

The record of the event demonstrates several instances of complacency when referring to the TFP Test Tank.

For example, Mr. Foust in his statement to OSHA indicated the following.

> *"What I was doing on the day of the accident doesn't actually apply to anything to do with fire extinguishers. **I was just filling the cylinder with air all alone** - there was no chemicals or extinguishment in that cylinder." [p2, ¶4, L1 & 2].*
>
> *OSHA Statement Mr. Foust April 6, 2016 [115414-01(286333) - Investigations - Investigation - DocID 8229161.PDF]*

In deposition Mr. Harding stated the following.

> *Q. Have you ever been trained on the use of such tanks?*
>
> *A. The training I have received is on the fire suppression tank, not a test tank.*
>
> *Q. When you referenced that the training you have received has been on a fire suppression tank, can you clarify what type of tank you're talking about?*
>
> *A. Sure. There are several tanks in a fire suppression system, and they are full of liquid agent that are used for the purpose of suppressing a fire. It is a component of the fire suppression system.*
>
> *[Deposition Mr. Harding p16 Line 14 – 25 and p17 Line 1 & 2].*

Mr. Harding also indicates that he does not consider a Test Tank to be part of the fire suppression system.

> *Q. All right. Now, as part of the overall fire suppression system, is a test tank part of the system or not?*
>
> *A. It is not.*
>
> *[Deposition Mr. Harding p21 Line 22 – 25].*

Mr. Harding testifies that the factory certification training does not include Test Tanks.

> *Q. As far as the factory certification training classes were concerned, did any of those factory certification training classes encompass the subject matter of utilizing a test tank?*
>
> A. *No.*
>
> *[Deposition Mr. Harding p28 Line 22 – 25].*

The record establishes that; in terms of documentation, labeling, and training there is significantly more attention given to Agent Tanks as a compared to Test Tanks. With greater attention given to Agent Tanks as compared to Test Tanks, it could be interpreted that Agent Tanks containing various chemicals are significantly more dangerous and pose a greater hazard when handled, serviced and used than that posed by Test Tanks. However, the PCL-300T Test Tank is known to have "*the same inherent danger*" to those of the PCL-300 Agent Tank as relates to over-pressurization as Mr. Harding stated in deposition. [Deposition of Mr. Harding p33 Line 12 – 18 and p34 Line 5 – 7]

Q. Thank you. And generally speaking, what is your understanding of the inherent dangers of refilling a tank with compressed air?

A. Well, it's just compressed air, so if you -- if there's too much pressure, that would be the danger in itself.

Q. So do you have an understanding that overpressurization of a tank, such as a tank utilized in a fire suppression system, can lead to the tank exploding?

...

A. Okay. I would have to assume that it would be dangerous if you overpressurize a tank, yes.

Q. Does overpressurization include or exclude a test tank versus an agent tank, or is it still the same inherent danger if you overpressurize tanks?

A. I would say it's the same inherent danger.

The lack of documentation, information, instructions, intended use, guidance, labels, and hazard communication associated with the TFP Fire Suppression Tank involved in the event increases the probability that complacency in the handling, servicing, and uses of TFP Test Tanks is contributing factor to the event.

3.6 Sequence of Events, and Casual Factor Chain, Contributing Factor Summary

3.6.1 Over-Pressurization with Compressed Air

The Tyco Fire Products Fire Suppression Tank involved in this incident ruptured as a result of over-pressurization with compressed air to a pressure that exceeded the cylinders mechanical design capability.

3.6.2 Compressed Air Source Pressure Exceeded the Cylinder's Design Capability

The compressed air source, a Poseidon Cascade Storage Tank System with the available maximum compressed air pressure of 4,000 psig.

3.6.3 Lack of Over-Pressure Safety Relief Devices

Best practice design would incorporate over-pressure safety devices such as a relief valve, or over pressure rupture disc, or blow-out plug. Safety devices were absent from the system.

3.6.4 Informal on-the-job "Buddy Training"

Informal training often lacks structure, without an agenda, or specific learning objectives related to knowledge, skills, and abilities. Buddy training also has potential to propagate bad habits.

3.6.5 No Access to Manuals, and Service Procedure Instructions

Technicians performing maintenance and service do not have access to manuals, procedures, and instructions.

3.6.6 Tyco Fire Products Training Deficiency

Formal manufacturer's factory training is not available. The Tyco Fire Products training does not include instructions, procedures, or guidance for service technicians in the safe handling, recharging, use, or intended application of Fire Suppression Tanks such as the Test Tank that ruptured during this incident.

3.6.7 Tyco Fire Products Deficient Manuals

The Tyco Fire products Kitchen Knight™ and Kitchen Knight II Manufacturer's Design Installation and Maintenance Manuals do not include any information pertaining to the TFP Test Tank that ruptured during this incident.

3.6.8 Tyco Fire Products Failure in the manufacturer's Duty to Warn.

Tyco Fire Products failed to fulfill the duty to warn of any danger from the intended or unintended but reasonably foreseeable use of their Fire Protection System Test Tank.

3.6.9 Tyco Fire Products Duty to Warn anyone who could reasonably be expected to be harmed

Manufacturer's including Tyco Fire Products Duty to Warn extends to users, purchasers, and anyone who could reasonably be expected to be harmed when using the product. It is normal practice in the Fire Protection Equipment market for service technicians to perform routine maintenance and service for all manufacturer's equipment independent of status as authorized distributors. Tyco Fire Products failed in their duty to warn the service technicians injured in this incident.

3.6.10 Tyco Fire Products Failure to Label the Fire Protection System Test Tank that Ruptured

Product labels are a common method of communicating warning of dangers associated with use of a product. Tyco Fire Products provides no labels of any kind affixed to the Fire Protection System Test Tank that Ruptured in this incident.